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Before the
Federal Communications Commission
Washington, DC 20554

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In the Matter of	)	
	)	
Advanced Television Systems	)	
and Their Impact upon the	)	MM Docket No. 87-268
Existing Television Broadcast	)	
Service	)	

To: The Commission

COMMENTS OF TEKTRONIX, INC.

Tektronix, Inc. respectfully offers these comments in response to the FIFTH FURTHER NOTICE OF PROPOSED RULE MAKING adopted by the Commission on May 9, 1996.

1. Introduction and Qualification

Tektronix is a portfolio of measurement, color printing, and video and networking businesses dedicated to applying technology excellence to customer challenges. Tektronix is headquartered in Wilsonville, Oregon and has operations in 23 countries outside the United States. Founded in 1946, the company had revenues of $1.8 billion in fiscal 1996 and is celebrating its 50th anniversary this year.

1.1 Tektronix Measurement Business Division is the leading supplier of instrumentation for the television and related industries and a pioneer in the development of instrumentation for digital systems.

1.2 Tektronix Color Printing and Imaging Division is a leading supplier of color printers to the computer industry and computer users, and is a pioneer in interoperability of display and hard copy imagery.

1.3 Tektronix Video and Networking Division includes:

Network Displays, a group specializing in networked environments requiring interoperability of different computer platforms;

Lightworks Limited, a leading supplier of non-linear editing systems, particularly to the motion picture industry;

Grass Valley Products (formerly The Grass Valley Group, Inc.), a professional equipment manufacturer, active in the television broadcast, production, and post production industries for over 30 years.

1.4 Tektronix firmly supports the efforts to introduce Advanced Television Service to the United States. Tektronix has been a participant in Advisory Committee Working Parties, and is an active member of the Advanced Television Systems Committee (ATSC). In the matters addressed below, we believe we comment as a party experienced in the relevant technology and in the operational aspects discussed.

2. Tektronix Endorses the Comments of ATSC

Tektronix has reviewed the comments submitted by the Advanced Television Systems Committee, and enthusiastically endorses the positions presented therein. The following comments are intended to expand upon the ATSC comments in areas where Tektronix has specialist knowledge and, in some cases, to put forward a view somewhat stronger than the ATSC consensus position.

3. All Layers of the ATSC DTV Standard Should be Adopted

We agree with the ATSC statement that all layers of the DTV Standard should be adopted, for the reasons given. We would comment additionally that such action does not detract from the benefits of a layered Standard. Adopting all layers of the Standard will require use of the video formats specified *for transmitting video in the context of a universal access broadcast television system*. Additional Standards that are likely to be created, such as data delivery, may be used (where permitted by regulation) in place of the Video layer, or in addition to it, but still using the Transport and RF/Transmission layers of the Standard.

3. A "Sunset" Provision is Unnecessary

One value of a standard is that it focuses development effort on achieving the maximum possible value from the standardized system. The consumer benefits from compatible progress until technological advance is sufficient to merit the disruption caused by a change in standard. NTSC is a perfect example of this: performance of NTSC systems today is immeasurably better than in 1953, but consumer investments have been protected throughout this period. This approach to standards is, we believe, particularly important in a universal access broadcast system.

Like the ATSC, we believe that the fears expressed regarding the potential obsolescence of the DTV Standard are exaggerated. However, the very nature of the Commission and the conduct of its operations ensures that when the need for technological advance exceeds the value of maintaining the standard, appropriate representations will be made. We believe the public interest is best served by permitting this process to happen when the advocates of change consider there is an overwhelming case, rather than by setting some arbitrary date for review.

4. Receiver Standards

On this issue, Tektronix advocates a stronger position than the ATSC consensus view. The *raison d'être* of a broadcaster is to provide a universally accessible service. Broadcasters argue that if a population of "standard definition only" receivers or set-top boxes is permitted to enter the marketplace, commercial and public interest considerations alike make it very difficult for a broadcaster to start providing high definition service – programming that would be inaccessible to those receivers.

Members of the consumer manufacturing industry claim that all receivers will receive all of the formats without Commission mandates, but oppose such mandates. The claim may be correct, but in this case a mandate will do no harm. However, if one or more manufacturers were to produce, say, set-top boxes that received standard definition formats only, a significant population of such boxes could seriously jeopardize the value of the last ten years' work.

This is not a quality issue; we would agree that any necessary quality standards should be the subject of voluntary industry standards. The issue is functionality, and when it is mandated that all receivers should display closed captions from all broadcasts, it seems not unreasonable that presentation of picture and sound should also be mandatory. Tektronix suggests that all DTV receivers and set-top boxes should be required to provide picture and sound from any of the DTV formats.

5. The DTV Format Provides Excellent Interoperability

In 1994 the "Workshop on Advanced Digital Video in the NII" (WGADV) recommended rapid adoption of a digital television system based upon the Grand Alliance proposals. This conclusion was subsequently endorsed by the Information Infrastructure Task Force. We believe that these conclusions demonstrate a broad base of support for the DTV system among informed members of the computer industry. In our view, the remaining objections may be addressed as follows:

5.1 There are some who advocate a system whose parameters are chosen solely to facilitate operation with computers, and suggest that any concession to interoperability with existing television systems is inappropriate. Tektronix believes that such an approach is not in line with the Commission's intent, nor is it in the public interest.

5.2 Tektronix has strongly advocated the adoption of progressive scan formats, but does not oppose the inclusion of interlaced formats in the DTV Standard. The single high definition interlaced format provides a combination of spatial and temporal resolution that is not otherwise available; it also is the format most suited for transmission of existing high definition program material (1920 x 1035 / 2:1). The standard definition interlaced formats provide interoperability with existing television systems.

5.3 Some members of the computer industry seem to suggest that all video displays should be capable of resolving fine text and graphics when viewed from a short distance. This is not economically practical. The requirements of "workstation" displays, and "armchair" or "entertainment" displays are quite different. A discussion of these issues is contained in a paper submitted by Peter Symes to the WGADV. This paper may be found at http://www.eeel.nist.gov/advnii/symes.html, and is attached as Appendix A. It should be noted that *all* DTV formats support text and graphics when presented on a suitable display, and when the text is sized so as to be readable from the viewing distance appropriate to that format.

4. Conclusions

Tektronix welcomes the Commission's tentative decisions to adopt the ATSC DTV Standard, and to require digital broadcast licensees to use the full standard.

We believe that a sunset provision is unnecessary.

We suggest that all DTV receivers be required to display picture and sound for any of the formats included in the Standard.

We believe that the DTV Standard offers excellent interoperability, and that changes advocated by some members of the computer industry are not in the public interest.

Respectfully submitted,

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Appendix A

The National Information Infrastructure and the Grand Alliance ATV System

A Commentary on Some Aspects of Interoperation

Peter D. Symes, Grass Valley Group

(As submitted to the "Workshop on Advanced Digital Video in the National Information Infrastructure" held May 10-11, 1994, in Washington DC.)

1. INTRODUCTION

Two major advances in technology are in the planning process in the United States. The National Information Infrastructure (NII) will make a wealth of information easily accessible to industry, educators, and the public; the proposed "Grand Alliance" (GA) Advanced Television System (ATV) will allow the distribution of high quality pictures in digital form, and of other digitally encoded information. Both systems are digital in nature, and both are designed to be accessible to the public at large. It is recognized that efficient dissemination of information frequently requires a combination of images and other data. There is, therefore, enormous potential benefit if the two systems can work together effectively.

Much discussion of this issue has concentrated on the image scanning formats proposed for ATV, and how these relate to the requirements of computer displays. Detail on these issues have been documented elsewhere. This paper discusses some fundamentals of images and displays, and contrasts the requirements of a "real world" imaging system with those of a computer workstation.

The NII will be general purpose and will support a diverse and ever growing set of applications. Many of these applications will require display of text and graphics as on a workstation; some will require real world imaging; others will have very specialized display requirements.

The proposed ATV system addresses a very specific objective, and provides an excellent mechanism for transmission of real world images. As such, the GA system can be a key component of the NII. The paper discusses possible uses of the GA system by NII applications, and also suggests ways in which ATV could provide a part of the NII infrastructure.

2. IMAGES AND DISPLAY: DIFFERENCES IN OBJECTIVES BETWEEN ATV & THE NII

2.1. The Nature of Images

Computer systems and television systems both produce images on a display. However, the two systems are optimized for different types of image, and this leads to different design parameters and different compromises.

Television systems are designed to capture images (usually moving images) of the real world and to convey these images to a viewer - a concept similar to that of photography. To achieve pleasing results, artifacts resulting from the system used to sample the image must have low visibility to the viewer (for example, under normal viewing conditions, the viewer should not be aware of the line structure of the display). This requires that a television system limit fine detail in the image to that which can be accurately represented by the sampling system, without significant artifacts (the Nyquist rule). Television systems must not produce significant artifacts when fine detail moves across the sampling structure in any direction.

Computer images are usually generated by the computer from primitives. The primitives may be text characters from a font, or graphic objects such as lines, circles etc. The primitives are "rendered" by the display system into an array of memory elements (pixels), appropriate to the resolution of the display. The display system, can take advantage of its "knowledge" of the display to place the primitives in an exact relationship to the pixel array. This technique allows, to a limited degree, the use of finer detail than would be permitted by a Nyquist limited system. Computer applications take advantage of this approach to permit the display of, for example, single pixel lines.

The example of a single pixel line highlights one difference in objectives between television and computer imaging systems. The single pixel line is displayed correctly on a computer display only if it is exactly horizontal or vertical. If the line is rotated slightly, its display is heavily artifacted. Similarly, if single pixel lines or objects with very sharp edges are moved on the display, there is a high level of motion artifacting. In the computer world, this is a small price to pay for the additional precision possible in such applications as engineering drawings. In the world of television and natural imagery, a line should appear the same whether it is horizontal or nearly horizontal, and strong artifacts are not acceptable when an object moves.

It must be emphasized that neither solution is "right" or "wrong." There is a fundamental difference between a "scene" that a viewer will "watch" and an information rich image where the viewer is expected to "study" detail in small areas. Each approach represents an appropriate optimization of cost effective technology for a particular application. However, such differences must be considered when deciding how the technologies can best be used together.

2.2. The Nature of Displays

Both computer and television systems use some form of video display. However, not only are there differences in the nature of the image to be displayed (as discussed above) but the assumed viewing conditions are quite different for the two applications.

A computer display (the "workstation display") is designed to be "read." Typically, the viewing distance is less than two feet, and frequently the viewer will lean forward to study detail in part of the image. All parts of the image must have nominally the same quality. These conditions impose very strict requirements on the display - the dot pitch must be very small, brightness uniformity must be excellent, and registration, geometry and focus must be consistently good over all areas of the screen. With today's CRT technology these factors mandate the use of small deflection angles (90deg. or less). Interlaced displays are generally not acceptable for computer applications. Because the information being displayed is not Nyquist filtered, edges show pronounced flicker. An obvious example is the single pixel line discussed above - such a line will be displayed only on alternate fields.

The domestic television display (the "armchair display"), on the other hand, is designed for a typical viewing distance of seven to ten feet - a good distance for relaxed viewing. The displays must be bright, but relatively large dot pitches may be used. The human psycho visual system is quite tolerant of variations in picture brightness and quality. A typical television display will be much less bright at the edges than the center, and convergence, focus and geometry will all be substantially worse at the edges and corners than in the center. These compromises greatly reduce the cost of the display, and permit the use of wide deflection angles in the CRT (110 or more). This factor alone is important for television receivers as it permits quite large screen sizes with reasonable cabinet depths - an important factor in the living room environment. The use of interlaced scan also helps reduce the cost of the display, and will likely be chosen for many domestic displays even in the future. Such a display provides a very cost effective solution for entertainment viewing of television programs, but is quite unsuitable for computer applications.

Some measure of the significance of these factors can be obtained by looking at today's market. A 20" diagonal NTSC television receiver is regarded as quite small, and can be purchased for $200 - $300. A 20" diagonal computer display is regarded as quite large, and will cost $2,000 -$3,000. Some of this difference is attributable to the much larger volume of television receivers, but much results from the fact that the computer display is a precision instrument.

It may be argued that these distinctions are a function of CRT technology. Certainly at some time in the future directly addressable flat screen displays will be the norm for both television and computers, and issues such as geometry and convergence should disappear. However, the question of dot or pixel size will remain. For a given number of pixels and equal apparent size and sharpness, a display for a viewing distance of eight feet will be four times the size of one designed for viewing from two feet, and the pixel size and pitch will be four times greater in each direction. The workstation display will still be too small for entertainment viewing, and the armchair display will still be unsuitable for close viewing.

2.3. Interoperability - Video on Computer Displays

Despite the above, television and computer systems can interoperate to a useful degree, provided the limitations of the systems and the display environments are taken into account.

Neither the display nor the architecture of most computer systems is optimized for the display of video images. Nevertheless, many computer systems can display these images, usually in a window. Given the relatively small size of this window on a typical workstation display, the video information is frequently decimated for display (reduced to one fourth or less of the total pixels), and this substantially reduces the load imposed on the system while providing acceptable results. All modern computer displays utilize square pixels, so the computational load is much less if the video to be displayed uses square pixels. All proposed ATV formats have square pixels.

High quality workstation displays have a nominal display refresh rate of 75 Hz or above (some European administrations require 76 Hz or greater). Note that in most computer systems, all applications run asynchronously with respect to the display, and this is generally true for video display also. This results in display flicker with a frequency equal to the difference in the video frame rate and the display refresh rate. This is generally not disturbing if the frequency difference is 15 Hz or greater - a condition that is met with a video rate of 60 Hz and a display refresh rate of 75 Hz or more. It is important to recognize that if the video rate were to be increased to 72 Hz or 75 Hz as advocated by some parties, artifacts would be far worse as flicker rates of a few Hertz (or a fraction of one Hertz) are very disturbing. Acceptable results would be obtained only if computer display architectures were changed to synchronize the display refresh rate to the video frame rate (and this solution would be viable for only one video at a time).

2.4. Interoperability - Computer Information on Television Displays

Computer text and graphics can be carried by a television system and displayed on a television receiver provided the limitations of both are recognized and observed. On NTSC receivers the low luminance resolution and the very low chroma resolution have imposed severe limitations, and a resolution of 320 x 240 is the most that can be used with any degree of success. However, the viewing environment must also be considered; to the viewer of an armchair display interoperability is achieved only if the information being displayed can be used from the armchair. Successful interoperability of computer technology and NTSC receivers is characterized by applications such as on-screen programming of VCR's, where the information density is very low. (It should be noted that this comment applies to the general case of computer text and graphics. Even in NTSC, a system designed specifically for television can produce very useful graphics.)

In the ATV environment, the increased resolution of the system, and the likely improvement in display quality and size, mean that significantly greater information densities can be considered. Television transmission and display will be best utilized if text and graphics information is appropriately filtered. It is probable that computer generated information with a resolution of 640 x 480 can be carried effectively by any of the proposed Grand Alliance transmission formats, and displayed by most ATV receivers. Note that this is the resolution used by the majority of computer displays today.

The Nyquist filtering does impose some limitations. Information designed to exploit the characteristics of a computer display system and a workstation display will not be as effective when displayed on a television receiver. For example, a single pixel line will be made wider but less intense by the Nyquist filtering. (However, if such a line is rotated or moved, aliasing will be dramatically less than on a workstation display.) A progressive display will provide a more pleasing result than an interlaced display, but the Nyquist filtering will remove the gross artifacts that make interlaced displays unacceptable in workstation applications.

3. OTHER DIFFERENCES BETWEEN ATV AND THE NII

3.1. Specificity

The ATV system is designed for a very specific goal; to provide transmission of high quality moving pictures. Further, the system is optimized for "real world" scenes and so is designed to reproduce a sequence of bit-map images. Note that this is a very inefficient way to transmit computer generated (non "real-world") images. In the proposed Grand Alliance system, extensions are provided to permit the system to be used for more general purposes.

The NII, by its very nature, is general purpose. The intent is to provide access from businesses, schools and homes to any information that can be conveyed in digital form, wherever that data is located. Images represent just one possible data type, and real world scenes just one subset of that type. The ATV system can be a key element of the NII by providing the mechanism for conveying real world images when these are required.

3.2. Directionality

The ATV system is a broadcast system, designed to convey information from one point to many points. As such, the system design assumes that many users in different locations will want the same information. The system is uni-directional--no mechanism is provided for reverse information flow. However, 2-way protocols may be layered around the GA system when required, and cable systems could provide a reverse data path.

The NII will be useful only if a user can obtain the specific information he or she requires. Bi-directional information flow is a prerequisite. (Note that the required data bandwidth will almost always be asymmetric. In general a small amount of information from the user will result in a large amount of information being conveyed to the user This will be discussed below.)

3.3. Delivery Mechanisms

The ATV system is designed for transmission over a 6 MHz terrestrial television channel, or over a channel of a cable system. As an extension, the proposed Grand Alliance system is designed to permit delivery of ATV data streams over suitable high speed data networks such as ATM. The NII will have to use a wide range of transport mechanisms ranging from high speed Sonet backbones to local end POTS or conventional modems It will be able to employ the ATV system as a part of its delivery infrastructure.

4. COMPLEMENTARY USES OF ATV AND THE NII

Much discussion on interoperability between ATV and the NII has focused on how ATV can be made to conform to the requirements of the NII and computer applications. As discussed above, there are many fundamental differences between the objectives of the two systems, and total conformity may not be possible. Some parameters are critical to ease of interoperation, most notably the use of square pixels which are now incorporated in all formats of the proposed Grand Alliance system.

Conformity may not only be impossible; it may be unnecessary and undesirable. Greater benefit may result from recognition of the fundamental differences and by appropriate complementary use of the systems, taking advantage of their differences

4.1. Real World Scenes as an NII Data Type

This is perhaps the most obvious cooperative application of the systems. When there is a need to transmit real world video scenes over the NII, the Grand Alliance system provides a mechanism for encoding this information. The manufacture of ATV receivers should mean that GA decoders are available at reasonable prices for inclusion in computer systems. The GA system includes provision for re-packaging GA data into ATM packets for transmission over NII infrastructure. (It is possible that future definition of a direct MPEG/ATM interface may offer greater efficiency.)

Note that any of the Grand Alliance video scanning formats may be used. If the highest possible resolution at the highest possible temporal rate is required, service providers could use the 1920/1080/60/2:1 interlaced format. If interlace artifacts are not acceptable, the choice may be made between lower spatial resolution (1280/720/60/1:1) or lower temporal resolution (1920/1080/30/1:1 or 1920/1080/24/1:1).

If the images are to be displayed on a workstation display, the GA decoder will likely be incorporated into the display system, perhaps permitting a variety of window sizes. In such an implementation large quantities of uncompressed video data will not need to be passed over the processor bus. If the images are to be displayed on an ATV receiver (perhaps in a classroom environment), the compressed data stream may be passed directly to the receiver provided a suitable data interface is standardized.

Some applications may not tolerate the artifacts that will result from the GA compression system, and lossless coding schemes may be required (a possible example is remote diagnosis). However, the GA system may be appropriate for still images even in critical applications - after a few frames the level of artifacts should be very low. The GA should be used within the NII when it represents the best tool for the job.

4.2. NII Data as Supplementary Information to Television Programs

Providers of educational programming (for example) may wish to supplement the video/audio material with other data types originating from the NII. The viewer might to choose to display this data on a separate workstation, or to superimpose it on the program video. If the supplemental information is transmitted as ancillary data over the ATV system, either choice could be made.

4.3. ATV as a Part of the NII Infrastructure

One of the most challenging aspects of the NII is the provision of suitable data paths to the community. Plans exist to provide such paths, but it will be many years before high speed data services are available at reasonable cost to most US households.

As noted above, the data bandwidth requirements for service of an NII user are typically asymmetric. A low data rate (and low cost) modem connection will usually be more than adequate for the information flowing from the user (and often for text based information going to the user). Images, even still images, and other large files require a higher bandwidth if they are to be transmitted to the user in a reasonably short time.

The ATV system has the potential to provide an important part of the NII infrastructure during the early years. Even when transmitting high definition video, a television station could provide perhaps 1 Mb/s for ancillary services. If the video is derived from a lower definition standard (as will be common in the early years of ATV), or from film (with its lower temporal rate), more data bandwidth could be made available. When the station is transmitting stills or graphics, a large part of the 19 Mb/s could be used for other data. If proposals to increase broadcasters' options for use of the ATV channel are adopted, very large data bandwidths might be available for part of the day. A cable operator may choose to dedicate one or more channels to data delivery. A single (RF) cable channel can provide 38 Mb/s.

All these services are broadcast, so the data capacity is available only once (per channel) to the whole community served. However, NII users requirements will be sporadic rather than continuous, so given a priority-based charging system, useful service could be provided. A market with five television stations could provide an average data rate of perhaps 10 Mb/s (about 100 Gigabytes/day) total to serve households not connected to high speed data services or cable.

The Grand Alliance has described a method for transmission of ATM packetized data within the ATV data stream. If ATM is to be the standard NII interface for personal computers, this would represent an appropriate mechanism. However, it may be preferable to strip ATM headers and re-packetize data addressed to an NII user. Simpler interfaces could then be used from the ATV decoder to a personal computer.

4.4. Graphics Services

Bit map representation of an image is appropriate for real world scenes, but very inefficient for most computer generated visual information. The NII will need to transmit a great deal of graphical information and, in general, the software application that generated the information will not be available at the receiving computer. There is a need therefore for an NII Standard, perhaps consisting of a set of graphics primitives, that will be implemented by all NII compliant terminals. (an existing standard such as X-Windows may be chosen).

Television broadcasters and cable companies need to superimpose graphics (logos etc.) over network video feeds. A conventional approach to this problem would require that the network signal be decoded at the local station, and re-encoded after adding the graphic. This process is expensive, and will cause significant signal degradation. An alternative is to add the graphic at the receiver. If the receiver decoder incorporated graphics primitives, the logo information could be sent over an ancillary data channel and the bit-map generated in the receiver. There may be an opportunity for the television industry to use a subset of NII graphics primitives within ATV receivers.

5. CONCLUSIONS

5.1. Concentration on a Common Display for ATV and the NII is Counterproductive

As discussed above, there are fundamental differences in requirements for workstation displays and armchair displays. A display that is large enough for entertainment viewing would be unacceptably expensive if it also had to meet the requirements of a high quality workstation display. In fact, such a display is likely to be more expensive than two separate displays, each optimized for its application.

Most users of the NII will require a personal computer with its own display. The goal of widespread use in US households will not be met if NII access inhibits simultaneous viewing of entertainment television. The ability to display NII information on an ATV receiver will certainly help to achieve initial penetration of the NII, but this can be achieved if the ATV system can utilize a resolution of 640 x 480 for NII applications. This format must be supported by the NII as it represents the majority of computer displays in the market today. (Note that for maximum accessibility the NII should also be accessible via a low-cost adapter feeding an NTSC receiver, probably using a resolution of 320 x 240. There are well over 100 million such receivers in the USA today.)

It must be emphasized that there can be no single display format for the NII. The minimum requirements should be as low as possible to maximize accessibility, but some applications will require much higher quality than the minimum. Users of such applications will need to have a suitable display.

5.2. Interoperability is Not the Same as Conformity

Some common ground is essential for interoperability, but the greatest benefits of cooperative use are obtained by exploiting the strengths of each technology. The NII will use many tools, and ATV will be most useful as an NII tool if it is optimized for the transmission of real world images.

5.3. ATV Interlace in No Way Inhibits Interoperability with the NII

No NII application has to use the interlace format. As discussed above, an NII service provider can and should choose the format most suited to the application.

Interlaced displays would likely be used on some ATV receivers even if the interlaced transmission format were to be abandoned. Receiver manufacturers will offer a range of models with different compromises on size, quality and cost.

Quite apart from the views expressed by the computer community, there are many in the television industry who would prefer that the ATV system include only progressive scan transmission formats. The forthcoming tests of the Grand Alliance system should provide good data on viewers' preferences for higher resolution with interlace, or lower resolution progressive. The tests will use many different types of source material and should reveal whether there is benefit in retaining an interlaced format. Whatever the outcome, this decision should be left to the television industry, and this can be done without detriment to the NII.

5.4. Cooperative Use of ATV and the NII Can Provide Many Benefits

The Grand Alliance compression scheme can be used within the NII for coding video and audio data types. Terrestrial broadcast and cable systems transmitting ATV may be able to provide a valuable contribution to the NII infrastructure and improve the accessibility of the NII, particularly in the early years.

Appropriate interoperability can greatly enhance television programming services, particularly for education. Use of NII technology may assist broadcasters in deployment of ATV.

5.5. Interfaces Must be Defined

Provisions have been made for conveying ATV data over ATM systems, and for conveying NII data over the ATV system. Cooperative use of ATV and the NII will require connection of ATV receivers to personal computers and/or computer networks. Rapid definition of hardware and software interfaces is essential if these connections are to be possible with early ATV receivers. The television and computer industries should work together closely to ensure that the potential benefits are not lost.